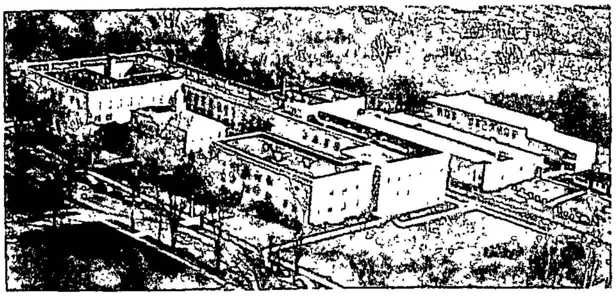

THE INSTITUTE OF PAPER CHEMISTRY, APPLETON, WISCONSIN

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

Project 2256

Report Seventeen

A Monthly Report

to

U. S. ARMY CHEMICAL CENTER PROCUREMENT AGENCY

Report Period: March 1, 1962 to March 28, 1962

May 1, 1962

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

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Contract No. DA18-108-405-CML-941
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TABLE OF CONTENTS

	Page
SUMMARY	1
THE EFFECTS OF REFINING AND WET PRESSING	3
Laboratory Refining	3
The Effect of Commercial Refining	6
FUNGICIDES	9
APPENDIX	14
Wood Conversion Co. Mill Freeness Test	14

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

SUMMARY

Evaluation of the laboratory refining series was completed. With the exception of boards made from the unrefined pulp (which had large undefibered bundles) all boards were satisfactory in aerosol resistance and charcoal retention; density of these boards was increased with higher wet pressing and, to some extent, with increased refining but the latter effect was surprisingly small. Diffusivity decreased with increased density and strength increased with increasing density. However, in the range studied, with a given degree of wet pressing, refining beyond a minimum required to brush out the undefibered bundles had little effect on strength at a given density and not a great effect on the density itself. Although comparison at the same density was not possible the strength obtained on these boards seemed to be significantly less than that which had been obtained on the boards made in the pilot run at Bauer Brothers Company. Water absorption and tensile strength after two hours' water immersion was also disappointing in comparison with these previous results.

Samples of pulps refined in commercial refiners were obtained from Wood Conversion Company and given a preliminary evaluation. At a given freeness these pulps had a radically different fiber classification than the pulps refined in the laboratory. Boards were formed from these commercially refined pulps and evaluated for density and diffusivity. Based on the assumption that the maximum density consistent with obtaining the required diffusivity would be beneficial for gas life and strength, a degree of refining represented by the pulp designated as No. 2 Slow Stock was chosen as the basis for further work and a larger sample of this pulp requested from Wood Conversion Company

THE EFFECTS OF REFINING AND WET PRESSING

LABORATORY REFINING

Previous work on this project has been carried out largely on commercial pulps suitable for insulating board manufacture and supplied by various manufacturers. In the pilot run at Bauer Bros. Company (Report Nine) additional refining of the pulp received from Wood Conversion Company was required to obtain the desired density. In preparing for the production trials, preliminary experiments on the effects of refining were included for guidance in the production runs. The first data on these trials, using a laboratory Sprout-Waldron, were covered in Report Fifteen.

Samples of these refined pulps were tested for freeness by Wood Conversion Company, using their "mill freeness" test which is especially adapted for evaluating stock of this type. (See Appendix for description.) A greater spread of freenesses was obtained than with conventional methods (Table I); these results did not correlate completely with the previously reported freenesses, but did correlate with the refiner settings. A different method of calculation of fiber classification data showed it to correlate also with the refiner settings although the differences between the 0.015 and 0.030 settings were very small. Evaluations of the boards made from these pulps were completed and all results are shown in Table II. Charcoal content was calculated from ash tests and shows good retention. Diffusivity decreases primarily with increased density, with possible secondary effects depending on fiber length or other pulp characteristics.

The D.O.P. smoke penetration tests indicated satisfactory aerosol protection (i.e., less than 0.01[illegible]% penetration) for all of the boards [illegible]

TABLE II

EFFECTS OF REFINING ON DIFFUSION BOARD PROPERTIES

[illegible]	Pulp Refining, [illegible] Setting, in.	Pulp Freeness: Wood Corr. ([illegible]), [illegible]	Pulp Freeness: Can. Std. (3 g.), [illegible]	Pulp Freeness: Green (3 g.), [illegible]	Wet Pressing, p.s.i.	Caliper Av., in.	Density, lb./cu. ft.	CO_2 Diffusivity, sq. cm./sec. x 10^{4}	D.O.P. Smoke Penetration, one liter/min. flow: ΔP_1 mm. H_2O	D.O.P. Smoke Penetration, one liter/min. flow: %	Water Absorption, % based on dry vol.: 2-Hr. Immersion	Water Absorption, % based on dry vol.: 24-Hr. Immersion	% Charcoal By Ash	Beam Strength: Breaking Load, lb.	Beam Strength: Modulus of Rupture, p.s.i.	Tensile Strength: Dry, p.s.i.	Tensile Strength: Wet, 2 hr. Soak, p.s.i.
[illegible]	Unrefined	[illegible]	700	665	150.	0.295	21.32	2.40	3.0	0.012	11.2	24.0	20.01	3.25	273.5	214.5	61.2
[illegible]	Unrefined	[illegible]	7[illegible]0	655	100	0.311	19.95	2.75	11.5	0.080	12.9	26.2	19.84	3.00	263.7	161.2	62.8
[illegible]	[illegible]	[illegible]	720	610	150	0.269	25.00	2.10	32.0	0.001	9.6	21.8	19.11	5.45	602.1	423.0	234.3
[illegible]	[illegible]	[illegible]	700	610	100	0.300	23.21	2.44	23.8	0.001	7.4	23.0	20.40	4.50	441.1	319.8	149.0
[illegible]	[illegible]	[illegible]	700	610	50	0.334	20.74	2.33	15.5	0.001	7.4	20.5	20.58	4.20	333.2	237.1	127.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	150	0.277	24.64	2.30	29.0	0.001	9.8	22.8	21.17	4.65	446.9	393.8	176.3
[illegible]	[illegible]	[illegible]	710	630	100	0.292	23.54	2.43	25.8	0.001	8.4	19.5	21.24	4.02	316.9	317.5	126.4
[illegible]	[illegible]	[illegible]	710	630	50	0.332	20.96	2.90	15.2	0.002	7.6	18.2	21.38	3.88	277.3	233.0	96.6
[illegible]	[illegible]	-35	635	595	150	0.266	19.95	1.86	37.5	0.001	8.3	19.0	21.02	5.12	508.6	564.0	263.7
[illegible]	[illegible]	-55	695	595	100	0.291	23.36	2.16	34.0	0.001	5.0	19.4	21.05	5.08	536.2	231.6	213.3
[illegible]	[illegible]	-35	655	595	50	0.324	21.46	2.70	25.8	0.001	7.4	17.4	21.28	5.48	398.1	286 1	129.9
[illegible]	[illegible] 0.030, [illegible] 0.001				150	0.274	25.56	2.02	37.5	0.001	9.4	24.1	20.50	4.72	494.8	425.7	184.1
[illegible]	[illegible], [illegible] 0.001				100	0.296	23.82	2.17	28.5	0.001	7.9	21.6	20.68	5.70	454.4	316.8	165.2
[illegible]	50% 0.030, 50% 0.001				50	0.330	21.30	2.48	18.2	0.002	7.2	20.6	20.41	5.38	397.5	249.7	134.5
[illegible]	70% Unrefined, 30% 0.001				150	0.294	23.65	2.43	17.5	0.002	11.1	26.4	19.70	3.32	270.6	226.9	87.8
[illegible]	70% Unrefined, 30% 0.001				100	0.327	21.35	2.71	15.8	0.004	8.8	23.6	19.91	3.20	227.0	180.3	80.6
[illegible]	70% Unrefined, 30% 0.001				50	0.348	19.56	3.05	12.5	0.020	7.8	20.3	20.80	2.68	203.5	181.2	64.0

tested by Wood Conversion Company and also in the Institute laboratories; these results along with Bauer-McNett fiber classifications are shown in Table III. By comparison with the pulps refined in the laboratory Sprout Waldron (Table I), it is apparent that the laboratory-refined pulps have a much greater fiber length (as measured by fiber classification) at a given freeness than the commercially refined pulps.

Boards containing additions of 0.5% active Aquapel 360, 0.2% active Kymene 557, and 25% charcoal were formed from the Bauer refined pulps and pressed while wet for 10 minutes at 100 p.s.i. Boards were also formed from these pulps without sizing or charcoal additions with the same level of wet pressing. (The latter boards were formed primarily to permit Wood Conversion Company personnel to compare the densities of boards produced in the Institute laboratory with the densities of board formed on Wood Conversion's laboratory and production equipment with the same pulps.) The densities of these boards were determined as were the carbon dioxide diffusivities of the charcoal-loaded boards. The results of these measurements are presented in Table IV. On the assumption that the highest density permitting adequate diffusivity (2.5×10^{-3} sq. cm./sec.) would be desirable for strength, board formed from the No. 2 Slow Stock seemed to most nearly fit this criterion; consequently, approximately 30 lb. ovendry fiber basis were requested from the Wood Conversion Company for further work.

FUNGICIDES

A review of the fungicidal materials that have been tested and considered in this program indicated that either Cunilate No. 2419 or Copper Pentachlorophenate might be of value in diffusion board. Boards were made up with additions of Cunilate No. 2419 (on the basis of copper-8-quinolinolate) and with sequestered copper pentachlorophenate (on the basis of the predicted yield of copper pentachlorophenate from Dowicide G and copper sulfate). These additions ranged from 1.0 to 0.3% active material. Sizing additions consisting of 0.5% active Aquapel 360 and 0.2% active Kymene 557 were made to each board in order that the evaluations of the fungicides could be carried out in board approximating the board that would be produced commercially in terms of additive systems.

The Wood Conversion No. 2 Slow Stock selected for other laboratory work with additive systems was not yet available and a batch of the Wood Conversion pulp used in the refining studies was refined in a Sprout Waldron at a plate clearance of 0.015 in. A single refiner batch of pulp was not sufficient to produce all of the series of boards, necessitating the use of a second refiner batch refined at the same setting (due to some lack of control in the operation, not an exact duplicate of the first refiner batch). Board samples 2085-13-1 through 2085-13-9 were made with pulp having a Canadian Standard Freeness (3 g. ovendry fiber charge) of 655 cc. and a Green Freeness (5 g. ovendry fiber charge) of 545 cc. Board samples 2085-13-10 through 2085-14-5 were made with pulp having a Canadian Standard Freeness of 670 cc. and a Green Freeness of 570 cc. The formed boards were wet-pressed to 10 min. at 50 p.s.i., dried for 3 hours at 105°C., and sealed in polyethylene bags. Specimens for gas life tests were cut at the Institute, sealed in polyethylene bags, and shipped to the Army Chemical Center for testing.

With this background the gas life results received later for the current series of fungicide-treated boards (Table VI) were surprising and disappointing. In comparing the copper pentachlorophenate-treated boards of this series with the previous boards (assuming no deterioration of the charcoal supply or the sizing materials) there are two apparent differences, either of which might be the cause of the vast differences in gas lives; the boards were formed with pulps of similar source but different refining treatments and the current boards were sized while the former were not. The inordinately low gas lives of the sized blank boards included in the latest series seem to indicate that neither the sizing nor the copper pentachlorophenate are directly responsible for the poor gas protection.

This leaves only the pulp as an obvious possible cause of the poor gas life. The pulp differences that could cause one board to have adequate gas life and another to have poor gas life would have to be either in the chemical natures of the pulps or the physical fiber characteristics. The latter, it seems, would be evident as poor charcoal retention in the boards with poor gas life; however, the ashing tests discussed in the pulp section of this report indicate good retention of charcoal with Sprout Waldron refined pulps. At the present time the effects of these pulps are being studied and the possibilities that the charcoal and sizing materials used in these boards could have deteriorated are being investigated.

Notwithstanding the reduced gas lives, the data in Table VI show a definite difference in the effects of Cunilate and copper pentachlorophenate on gas life. The gas lives of the Cunilate-treated boards when compared to the blank boards indicate a drastic loss at all addition levels which would [illegible] Cunilate-treated boards unsatisfactory even if there were no [illegible] factors affecting gas life. From the standpoint of gas life the copper pentachlorophenate is the more desirable additive of the two at comparable levels of addition. Another material presently being considered as a fungicide or mildew-inhibiting additive is zinc oxide on the basis of its use in some points for that purpose and suggestions by companies manufacturing zinc oxide. Since zinc oxide is also being considered for use as a stabilizing material there is no question concerning its compatibility with the ASC charcoal.

THE INSTITUTE OF PAPER CHEMISTRY

L. E. Leporte

L. E. Leporte, Research Aide

T. A. Howells/xl

T. A. Howells, Chief
Special Processes Section

Procedure: The following procedure shall be known as "mill freeness by laboratory technique".

1. Select 20 grams of fiber ovendry weight basis and thoroughly disperse in 4 liters of water at 70°F. (this is approximately the city tap water temperature).

2. Pour the stock suspension into the cylinder (bottom closed).

3. Open bottom immediately allowing the water to drain from the fiber into the cone funnel.

4. Collect the overflow (side orifice) of the divided cone funnel in a graduated cylinder and record result in cubic centimeters of water.

In routine control work in the mill the test is performed by an alternate method with respect to the selection of the proper weight of fiber. To avoid drying of the fiber to determine its consistency, one liter of stock at consistency of process is formed into a mat in a sheet mold. The consistency of this mat is approximately 11% and [illegible] grams are taken for test to give approximately [illegible]0 grams of dry fiber. Subsequent operations are similar to those described above.

Report: Record freeness by laboratory technique as cubic centimeters of water.